

Impacts of Feebates on U.S. Light-Duty Vehicle Fuel Use and Greenhouse Gas Emissions

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1. INTRODUCTION

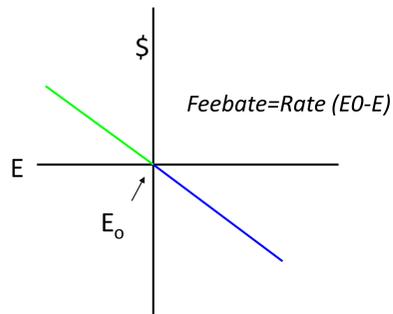
Research Objective

Study the impact of feebates (on the top of fuel economy and GHG emissions standards) on fuel efficiency improvement and consumer demand, and resultant Fuel use and emissions.

Background

Feebate is a market based policy for new vehicle purchases

- A fee on fuel-inefficient vehicles
- A rebate on fuel-efficient vehicles
- Feebate structure: Benchmark, feebate rate and functional form



Overview of the Approach

- 1) Feebate Analysis Model:** Predict new vehicle fuel efficiency improvement and consumer demand
- 2) Stock Model:** The output of feebate model are entered into the vehicle stock model to simulate the evolution of the entire vehicle stock and thereby estimate the impact of feebate on the whole stock.

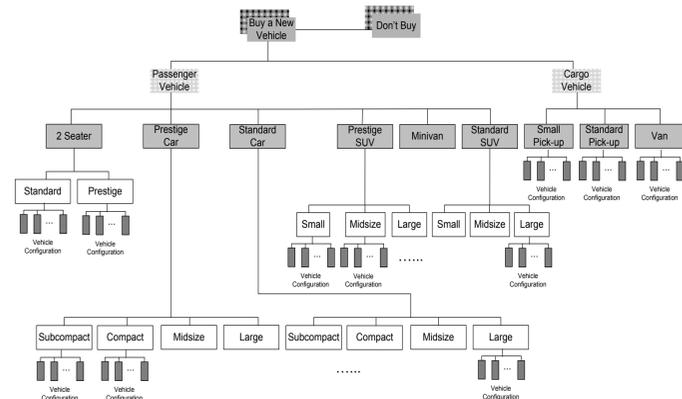
2. METHODOLOGY

Feebate Analysis Model

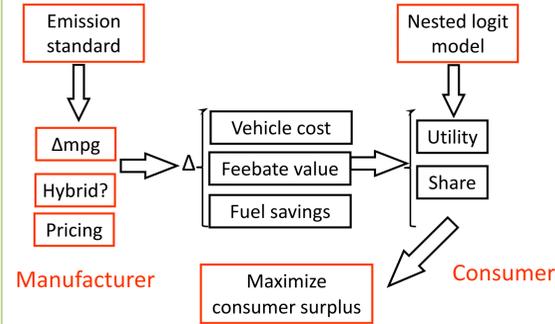
A **dynamic optimization** model to simulate manufacturers' decisions in product offering and pricing, and vehicle design while considering

- technology cost in improving fuel efficiency (represented by cost curves)
- consumer response (simulated by a Nested Multinomial model)
- incentives of feebates and meeting fuel economy/emissions standards

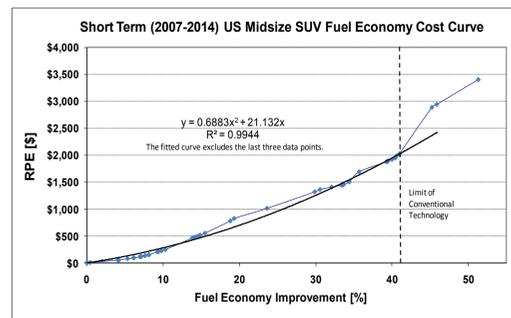
Nested Structure of the Logit Model



Model Framework



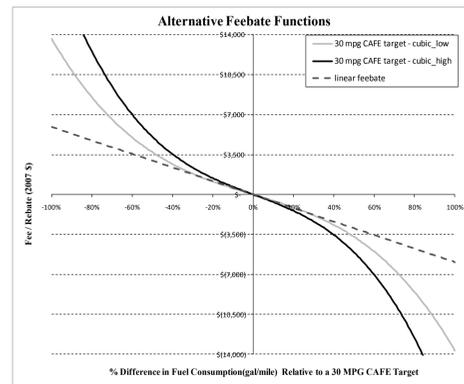
Technology Cost Curves



3. RESULTS

Model Setting & Assumptions

- One reference scenario: emission standards only, no feebate
- Six feebate scenarios: 3 feebate functions and 2 types of benchmark
- Planning horizon: feebate model (2011-2020); stock model (2011-2050)
- Assume consumers under value fuel savings
- Assume medium hybridization cost



$$feebate_i = AE_i^B \left(\frac{E_i - E_i^B}{E_i^B} \right)^3 + BE_i^B \left(\frac{E_i - E_i^B}{E_i^B} \right)$$

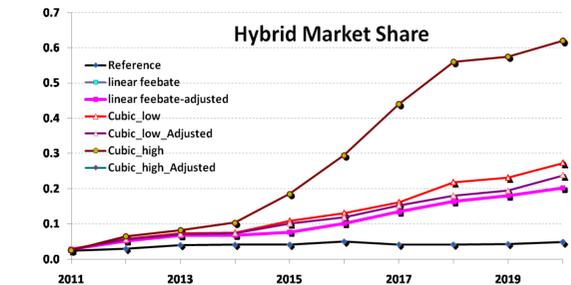
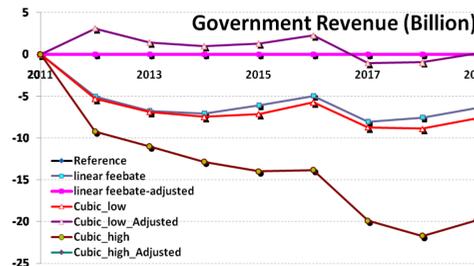
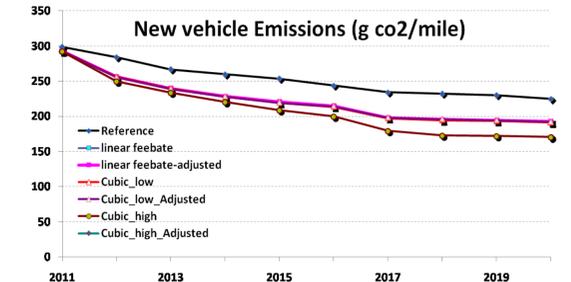
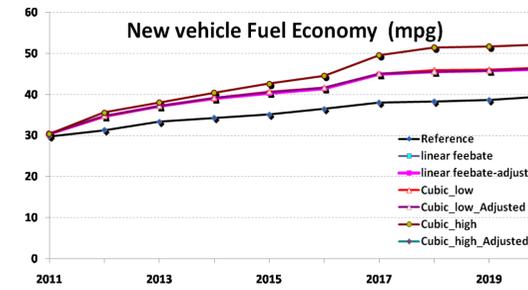


Table: Summary of feebate impacts: 2011-2050

	Ref.	Linear	Linear-Adjusted	Cubic_low	Cubic_low-Adjusted	Cubic_high	Cubic_high-Adjusted
2011-2050							
Government expenditures (\$ billions)	--	\$41	\$0	\$46	-\$7	\$98	\$17
Fuel expenditure savings (\$ billions)	--	\$359	\$379	\$370	\$392	\$554	\$536
% Reduction in fuel use	--	9%	10%	10%	10%	15%	14%
% Reduction in GHG emissions	--	9%	10%	9%	10%	14%	14%
% Reduction in fuel expenditures	--	7%	7%	7%	8%	11%	10%
2050							
Hybrid market share of new LDVs	5%	20%	20%	27%	24%	62%	52%
Average MPG of new LDVs	37.1	42.8	42.8	43.2	43.0	48.0	46.6
Annual fuel savings (billion gallons)	--	14.1	15.1	14.6	15.7	23.1	22.3
Annual GHG reductions (MMTC)	--	43.0	46.0	44.4	47.9	70.4	68.2

4. DISCUSSION

- **Feebates can produce additional reductions in fuel use and GHG emissions, even fuel economy and emissions standards are in effect.**
- **Feebates (e.g. cubic feebate) can provide a strong incentive to hybrid vehicles and thus encourage the rapid market penetration of hybrids**
- **Feebate benchmark shall be appropriately designed to control government expenditure within a reasonable range.**
- **Analysis results are subject to the assumptions on technology cost of improving fuel efficiency, fuel cost, and hybrid vehicle cost. Deviations from these assumptions could significantly alter the results.**
- **The next step of study is to include PHEVs and other advanced technology in the analysis.**

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